1.0 SCOPE

This standard covers the design, construction, installation, operation, maintenance and testing of man riding car by rope haulage system used for transportation of persons in mines.

2.0 Design, construction and installation of man riding haulage engine.

Every part of the system shall be of good construction, suitable material, of adequate strength and free from visible defect and shall be properly maintained. Every man riding car by rope haulage system and each of the accessories thereof shall so far as is practicable be constructed of non-inflammable material and any inflammable material, if used, shall be shrouded with a substantial metallic covering.

2.1 Design of haulage engine:

a) The haulage engine shall be located in properly built engine house.

b) The haulage engine shall be firmly connected to a rigid foundation and shall be so designed, constructed and maintained that with the power provided, the raising and lowering of persons can be carried out with ease, reliability and safety.

c) Design of the drum shall be such that its flanges are sufficient to prevent the rope from slipping or coiling unevenly.

d) Every haulage engine shall be provided with adequate guards or fencing.

e) The design of the direct haulage engine shall be such that frame and all the components can be easily dismantled without much difficulty for transportation and maintenance in the mine.

f) There shall be two exits provided at engine driver room.

g) The material specification of haulage drum and gear box are given at **Annexure- A.**

2.2 Mechanical Details:

As per statutory and other specific requirements, the direct rope haulage for transporting persons in mines shall conform to the following requirements:

a) Drum diameter in mm	minimum 80 times of rope diameter.
b) Drum width in mm	minimum 60 times the rope diameter.
c) Flanges diameter in mm	minimum 100 times the rope diameter.
d) Rope capacity on drum	up to 2000m.

2.3 Maximum Speed:

The normal working speed of man riding car shall be fixed by manager in consultation with engineer and original equipment manufacturer and shall not exceed 8.0 km/h(eight kilometer per hour). The speed adjustment arrangement shall be made available at haulage engine. The variation of the speed of man riding car during acceleration or deceleration shall not be such as to give rise to any signs of discomfort to the persons.

2.4 Brakes:

a) There shall be provided with at least two independent brakes.

b) A service brake shall be fitted to haulage engine drum and shall have a braking capacity of 1.5 (one and half) times the static torque.

c) An emergency brake system independent of service brake system shall be fitted and the braking torque shall be 3.0 (three) times the torque resulting from the maximum rope pull.

d) A separate emergency hydraulic shut-off valve shall be provided near to operator, to apply brakes (by draining the hydraulic oil in the circuit) in case of failure of pilot control or other systems, in emergency.

e) The material specifications of brakes are given at **Annexure-B.**

2.5 Safety features in haulage engine:

a) Every engine shall be equipped with a reliable distance indicator showing to the engine driver the position of the man riding car throughout the run, and an automatic device that will ring a bell in the engine room when the car is approaching boarding or alighting station, at a distance of not less than two revolutions of the drum.

b) An automatically recording speed indicator, over travel limit switch and over speed trip switch shall be provided in the haulage engine. The over speed trip switch shall be set at 10 percent more than normal speed of rope.

c) A dead man's handle shall be provided in order to stop the haulage engine in the event of collapse or incapability of the operator.

d) Slack rope protection shall be provided.

e) Slow banking device shall be provided so that man riding cars will travel at less than 1.5m/sec when it is being hauled at stations.

f) Push button switch arrangement shall be provided to switch off the haulage engine in case of emergency.

2.6 Lowering of men:

Lowering of men with controlled speed mechanism by means of regenerative braking or variable frequency drive system or any other equivalent system shall be provided.

3.0 Rope and cappel:

3.1.1 The wire rope shall be approved by Chief Inspector of Mines and shall conform to IS 1855:2003 or its revised version with minimum size of 26mm diameter, construction of stranded 6x7, galvanized, lubricated with fiber core. The fiber core shall conform to IS 1804:2004 or its revised version.

3.1.2 The minimum breaking load of wire rope shall not be less than 10(ten) times the maximum pulling load by haulage.

3.1.3 Care shall be taken to avoid any twisting or kinking of the rope while un-reeling of rope during installation.

3.1.4 The end of the rope shall be securely fixed to drum in such a manner that the rope is not unduly strained. There shall be at least two turns of rope on the drum when the car is at lowest working point.

3.1.5 Spliced rope shall not be used on any direct rope haulage system.

3.1.6 The lubricants used in the wire rope shall not cause any corrosive action on the wire rope.

3.1.7 In-situ Non Destructive Test of all vital components of haulage engine and man raiding cars along with wire rope shall be tested once in every six months conforming to at any Government approved laboratory or a test

house accredited by NABL (National Accreditation Board for Testing and Calibration Laboratories) subject to confirmation of its ability to conduct such tests The testing laboratory shall have valid NABL accredited certificate for the purpose and testing personnel having valid competency level-II certificate for NDT issued from Indian Society for Non – Destructive Testing (ISNT)/American Society for Non – Destructive Testing (ASNT) and test reports certified by Competency level –III person issued from ISNT/ASNT, which may be accepted by Chief Inspector of Mines on the basis of the authenticity/legitimacy of the test house.

3.1.8 Rope capping shall be carried out as per regulation 85(5) of Coal Mines Regulation, 2017 or 88(5) of Metalliferrous Mines Regulations, 1961 at least once in every 6 (six) months, or if necessary, at short intervals as decided by mine manager. Before every such recapping, a length, including the capping, of at least 3.0(three) meters shall be cut off the rope and same wire rope sample shall be tested at any Government approved laboratory or a test house accredited by NABL may also be accepted, subject to confirmation to its ability to conduct such tests for break load and tensile, torsion & bend test of wires.

3.2 Rope life and discarding factors

The life of rope shall be fixed by mine manager in consultation with engineer and in any case it shall not be more than 2 years and the norms of discarding of the rope shall conform to DGMS Tech. Cir. 77/1963 or its revised version along with the following additional conditions:

a. Reduction in diameter of the rope is 10% of the original diameter when new, anywhere along the length of the rope.
b. Broken wires with in any one strand exceed 15% of the total no. of wires in that strand.

3.3 Conical white metal rope cappel shall conform to DGMS general order No. DGMS/Mech/Tech.Cir.(Approval) No.01 dated 13.02.2015 or its revised version and shall be used with the man riding haulage rope. The cappel of the rope shall be treated as part of the suspension gear of winding system and shall conform to IS 7587:2006 or its revised version. Bent wire cappel shall not be used with man riding haulage system. The rope shall be secured tightly in ham bone clamp by 16 numbers of M 20 bolts. These bolts shall be tightened with a minimum torque of 220 N-m.

3.4 In man riding car system by endless rope haulage, periodicity of changing the position of man riding car clamps on the rope shall be decided by the mine manager in consultation with engineer and original equipment manufacturer. When the position of clamps, screws, clips or other attaching devices are changed, each shall be moved along the rope to new point of attachment at a distance not less than the maximum length of man riding cars and all such movements shall be in the same direction. Adequate number of clamp bolts shall be securely tightened to the rope to prevent slippage from the clamp.

3.5 The joint of endless rope haulage shall be long splicing joint with minimum over lap of 30 meters and shall conform IS 5245-1 :1969 or its revised version (the length of splicing shall not be less than 960 times the diameter of the rope). The number of joints shall not be more than two in the endless rope haulage.

4.0 Man riding car:

4.1 Man riding car shall be made either as per IS 9494:1980 or its revised version.

4.2 Rope anchoring car shall be provided with a head lamp that provides adequate illumination of the road way and track for a minimum distance of 60m (sixty meters). A red lamp at the rear of the man riding car of similar visibility shall also be provided. Head and tail lamps shall be kept 'ON' during operation.

4.3 Every car used for man riding shall be provided with safe and ergonomically designed seats and protected on sides and ends to prevent the persons from falling off the cars.

4.4 Provision shall be made for safety connection in between cars by D-shackle coupling. Safety chains may be centre buffer coupling (CBC).

4.5 The automatic over speed track brakes shall be provided and set to operate at 20(twenty) percent above the normal operating speed of the rope.

4.6 Each car shall be provided with hand levers to operate track brakes by persons traveling in cars in case of emergency.

4.7 Each car shall be hydraulically connected to adjacent car by quick release coupling or any other method in order to activate all brakes in all the cars to be applied at a time.

4.8 All man riding cars while carrying men shall not be used to carry materials.

4.9 Sufficient clearance shall be maintained between brake pad and track during operation. The brake shoe pads shall be provided with tungsten carbide nibs.

4.10 Man riding car brakes shall be applied to wheel or rail whichever is possible.

4.11 There shall be provision in the car to carry the injured person on stretcher.

4.12 The number of persons to be transported by man riding car shall be decided by the manager in consultation with the engineer and notice specifying number shall be prominently posted at every station.

4.13 The material specifications of cars are given at **Annexure- B.**

5.0 D- shackle, coupling and safety chain:

5.1 D- shackle, coupling and safety chain shall comply as per DGMS general order No. DGMS/ Mech /Tech. Cir. (Approval) No.01 dated 13.02.2015 or its revised version. The D-shackle, coupling and safety chain shall be treated as part of the suspension gear of winding system and shall conform to IS 7587:2006 or its revised version. The D- shackle, coupling and safety chain material shall be any of the following:

a) 20Mn2 confirming to IS 4432

b) 11Mn2 confirming to IS 1570

c) 20Ni 55 Cr 5Mo 20 to IS 4432

5.2 The factor of safety for both coupling and safety chains shall not be less than 10.0(ten). Safety attachments shall be provided between cars (chain or other suitable appliance) and shall be so fitted that they are not normally subjected to load and shall be adequate strength to sustain any shock load which might be imposed on them due to failure of the main chassis.

6.0 Route and Profile of the Roadway:

6.1 The axis of track line shall be straight and of regular gradient.

6.2 The profile of the haulage road way shall facilitate and allow persons to get down easily from cars in case of power failure or due to any other reason.

6.3 The roadway all along the travel and stations shall be specially secured against falls of sides and roof.

6.4 Man holes shall be provided all along the route as per Regulation 92(11)(12)(13)(14)(15)(16) of Coal Mines Regulations, 2017 and 95(6) of Metalliferous Mines Regulations, 1961.

6.5 The man riding car by endless rope haulage system shall not run in a steeper gradient more than 1:12.

6.6 The cars shall be capable of passing over rail track with minimum of 610 mm gauge.

6.7 In order to ensure free movement of passengers, the following distances shall be provided and ensured:

(i) Car top portion below the roof shall be sufficient to accommodate and operate the pantograph for signaling purpose, after duly considering the undulations, if any.

(ii) The clearance between the edge of the man riding car and side shall not be less than 1.0(one) meter.

6.8 Track used for man riding shall be installed and maintained as defined below:

(i) It shall be straight and leveled enough such that the travel shall be smooth without any jerks to the passengers.

(ii) It shall be properly ballasted and provided with proper drains.

(iii) The sleepers shall be placed at equal distances and the spacing shall be such that the sag of the rails by virtue of movement of the car wheel is minimized.

(iv) The rail used for the purpose of track shall have a weight not less than 60 lb/yard and shall be of uniform cross section throughout.

(v) Special attention shall be paid to rail joints to ensure that no step is formed by the rail ends and every rail joint shall be secured by suitable fish plates fitted with the required number of bolts.

(vi) Track limiting switches shall be provided to warn the engine driver of an impending over run and an automatic device shall be provided to stop the haulage engine after the warning has been given.

(vii) Suitable rope guide pulleys with lubricating arrangements shall be provided at frequent intervals to avoid rubbing of rope with sleepers or floor and such pulleys shall be secured/locked.

7.0 Signaling and communication system:

7.1 Pantograph/Radio remote signal system shall be provided in rope anchor car or leading man riding car to provide signals to Haulage driver.

7.2 Separate signaling system independent of pantograph/ radio remote signaling system along the haulage road ways shall also be provided.

7.3 Loud hailing communication system shall be provided along the road ways at a distance of every 200 m, in case of below ground coal mines it shall be

intrinsically safe and flameproof (wherever required) and shall have valid DGMS approval.

7.4 Adequate precautions shall be taken to ensure that the communication and signal cables do not come in contact with other cables and electrical apparatus.

7.5 Where signal wires are bare conductors, they shall be supported on suitable insulators and the voltage shall not exceed 30V.

7.6 The code of signals shall be used and strictly observed as per 92(5)(6)(7) of Coal Mines Regulations, 2017 and Reg.95 (4) (a) of Metalliferous Mines Regulations, 1961.

7.7 Pre-start warning alarm shall be of audio-visual type and provided at all stations and prominent junctions, to warn the persons. The pre start alarm shall give warning signal for at least 10.0 (ten) seconds before every start of the car movement.

7.8 A visual type warning system shall be provided all along the man riding haulage roadway and kept "ON" during entire operation.

8.0 Boarding and Alighting Stations:

i) Every station shall be white washed and adequately illuminated.

ii) Appropriate boarding or alighting signs shall be provided at the approach to each platform.

iii) At all stations, there shall be marked with restricted entry cautioning the persons not to enter until he has received permission from the train guard.

iv) An electrically lighted or red reflector type "STOP" sign shall be provided at each end of man riding haulage run.

v) At the end of the man riding haulage, the track is to be covered with suitable material like sand, etc. and provided with suitable buffer at the end to prevent hard landing, in case of uncontrolled movement of the man riding car.

vi) A suitable arrangement shall be made to inspect the bottom of the under carriage and bogie condition on a horizontal platform with protected roofing. (Repair Shed)

9.0 Electrical details:

The motor and other associated electrical controls and switchgear used for man riding car system shall be capable of hauling up and lowering of the persons with smooth controlled speed.

9.1 The electrical equipment for haulages shall be selected in accordance with IS 9559:1980 or its revised version and shall comply as per DGMS .Cir.Tech.13/1982 or its revised version. For use in belowground coal mines, all electrical equipments associated with the man-riding car system shall be of flameproof construction & intrinsically safe or intrinsically safe as per requirement, and such equipment/ apparatus shall comply to relevant applicable standards and duly approved by Chief Inspector of Mines.

9.2 All electric lighting fixtures shall be of flameproof construction. Provided that, the lighting fixtures may be of increased safety enclosure type 'e' in first

degree gassy mines at locations other than return airways and in-bye of the last ventilation.

9.3 A suitable Alternator and/or Battery with adequate capacity shall be provided in the car as power source to lighting system of the car.

9.4 All live parts shall be properly enclosed to prevent sparks, short-circuits etc, when persons coming into contact accidentally with them.

9.5 The relevant provisions of the Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010 as amended from time to time shall be complied in all matters relating to the installation, operation and maintenance of the equipment.

9.6 The cables shall comply to the provisions of the DGMS Tech. Circular (Electrical) Approval No. 12 dated 25.05.2015 and corrigendum vide DGMS Tech. Circular (Electrical) Approval No. 01 dated 19.02.2016 or its revised version in addition to the special requirements, if any, specifically for safe operation of the equipment.

9.7 All electrical equipment associated with the chair car shall be checked by electrical supervisor of the mine and the observations shall be recorded daily in a bound register kept for the purpose or in electronic form with due authentication.

10.0 General conditions:

10.1 Adequate lighting shall be provided at all stations and along the roadway.

10.2 Adequate number of competent persons including fitter, electrician, operator, rope splicer, and supervisors (Electrical, Mechanical & Mining) etc. shall be appointed.

10.3 An engineer shall be authorized to hold charge of man riding car system, and to be responsible for its installation, maintenance and safe working.

10.4 Regular inspections of the system i.e., shift wise, daily, weekly, monthly, half yearly etc., as per original equipment manufacturer manual, shall be carried out by a competent person appointed by the manager of the mine and results are to be recorded in bound page book or in electronic form with due authentication.

10.5 The Performance report of the man riding car system shall be recorded as per **Annexure-C** and the same shall be kept available at mine office along with test certificates of rope and vital components.

10.6 All fire resistant high pressure hydraulic hoses shall comply to the general order No. DGMS/Mech/Technical Cir.(Approval)/04 dated 13.02.2015 or its revised version and fire resistant hydraulic fluids shall comply to the general order No. DGMS/Mech/Technical Cir.(Approval)/02 dated 13.02.2015 or its revised version issued by this Directorate.

10.7 All technical circulars/guidelines issued from this Directorate from time to time in the interest of safety shall be complied.

10.8 The Chief Inspector of Mines may by an order in writing and subject to such condition as may be specified therein require any modifications or additional requirements to be included in this standard on merit of the case.

ANNEXURE A

LIST OF REFERRED INDIAN STANDARDS

BIS No. (or its revised version)	Title
28:1985	Phosphor bronze ingots and castings
210:2009	Grey iron castings – Specification
1030:1998	Carbon steel castings for general engineering purposes
2062:2011	Hot rolled medium and high tensile structural steel
1570(Part 1):1978	Schedule for wrought steels – Part 1 Steels specified by tensile and/or yield properties
1804:2004	Steel wire ropes – Fiber main cores – Specification
1855:2003	Standard steel wire ropes for winding and man riding haulages in mines Specification
7587(Part 2):2006	Cage suspension gear for winding in mines: Part 2 Cappels
9494:1980	Specification for man riding cars used in mining
9559:1980	Guide for selection of electrical and electronic equipment for mines

Material specifications for Main Assemblies in Man Riding Haulage System

Description of assly. Specification	**Description of Component**	**Material**
Hauler Drum Assembly	Brake Rim	IS 210/IS 1030 Casting
	Brake liner	Asbestos interwoven with brass wire
	Drum Support	IS 1030, Gr. 260-520 Casting
	Bush bearings	Ph.Bronze, IS 28, Gr 2 Casting
	Gear Box out put shaft (Drum shaft)	C 45(N), IS 1570 Forging
Gear box assembly.Housing Casting		IS 2062
	Bearing Housing	IS 1030, Gr. 260-520
	Input shaft	40Ni2 Cr1 Mo28, IS 1570
Forging	Intermediate shaft	C 45(N), IS 1570 Forging
	Input pinion	40Ni2 Cr1 Mo28,IS1570
	Intermediate gear	40Cr1 Mo28, IS 1570
	Intermediate pinion	40Ni2 Cr1 Mo28, IS 1570
	Out put gear	40 Cr1 Mo28, IS 1570
	Bearing Covers	IS 210 Casting
	Bush bearings	Ph.Bronze, IS 28, Gr 2 Casting
Emergency brake wire	Brake liner	Asbestos interwoven with brass
	Brake drum	IS 210 Casting
Caliper brake	Turn buckle	C45, IS 1570
	Tie Rods	C55, IS 1570
	Disc Spring	Material V/50CrV4, IS 12511Part 2
Cars	Brake pads	Tungsten tipped
	Bogie wheels	IS 1030, Gr 3 Castin

Bogie axle	En 36C
Rope guide	IS 210 Casting
Couplings	20 Mn2, IS 1570
Safety chains	20 Mn2, IS 1570
16 Bolt ham bone clamp	40Ni2 Cr1 Mo28, IS 1570 Forging
Bracket for 16 Bolt ham bone clamp	IS 2062, E250 Gr B
White metal socket	11 Mn2 of IS 4432/
Rope cappel	20Mn2 of IS 1570
Bracket for white metal socket rope cappel embarking	IS 2062, E250 Gr B

Typical Mechanical Properties – Quenched and tempered at 200°C

Section mm	Yield Strength MPa	Tensile Strength MPa	Elongation %	Impact Izod J	Hardness HB
25	950	1150	15	45	340
50	810	970	17	70	285
100	730	900	20	87	265

Typical Mechanical Properties for guidance only

ANNEXURE- C

PERFORMANCE REPORT OF MAN RIDING CAR BY ROPE HAULAGE SYSTEM

Date of Inspection:

MINE: **AREA:**

Sl.No	Description	Status
1.	Manufacturer Name	
2.	Hauler Capacity/ Make	
3.	Date of Installation	
4.	DGMS Approval No.	
5.	DGMS Permission No.	
6.	Valid up to:	
7.	Length of Man-Riding haulage	
8.	Permitted No. of cars and persons	
9.	**Route and Profile of Roadway**	
	Maximum gradient	
	Rail size (lb/yd)	
	Straightness and leveling of the Rail line	
	Minimum clearance between car and sides	
	Condition of ballasting	
	Provision of Manholes	
	Condition of rail joints with fish plates	
	Provision of cushioning at the end of the track	
10.	**Details of Haulage Engine**	
	Drum Diameter in mm	
	Condition of Foundation and bolts	
	Functioning of speed indicator	
	Functioning of car location indicator	
	Functioning of Automatic warning system during slow banking	
	Functioning of Dead man's handle	
	Functioning of slack rope protection	

	Functioning of over speed protection at motor (tripping speed, km/h)	
	Functioning of upper and lower over travel limit switches	
	Condition of couplings	
	Operator Comfort & lighting	
	Guarding of all moving parts	
11.	**Details of Rope and Cappel**	
	Rope Manufacturer	
	DGMS approval No.	
	Rope Test certificate No. and Reel No.	
	Rope Diameter in mm, construction and length of rope	
	Breaking strength (KN)	
	Date of installation	
	Restricted Rope life	
	Date of expiry of rope life	
	Date of recapping	
	Reduction in Rope diameter in percentage	
	Condition of Rope lubrication	
	Details of Rope Cappel: i) Name of the Manufacturer: ii) Capacity: iii) Test certificate No.: iv) Date of installation of Cappel: v) Restricted Cappel life:	
	Hambone clamp details: i) Test Certificate No.:	
	ii) Hambone clamp tightening torque, N-m	
	Condition of White Metal Rope Cappel with pin and locking arrangement	
12 .	**Powerpack Pump**	
	Working pressure, MPa	
	Condition of spare pump	
	Condition of oil and filters	
	Function of Filter choke indicator	
	Function of Hydraulic valves	
	Oil leakages if any	

13.	**Brakes Examination**	
	Performance of Thruster Brake	
	Performance of Caliper Brake	
	Performance of Inching Operation	
	Condition of brake paths on the Brake drum	
14.	**Man Riding Cars**	
	Condition of Brake Pads as per standard	
	Condition of D-couplings, links and Safety chains between cars	
	Anti-rust coating to all vital parts	
	Pressure in the car pressure gauge (PSI)	
	Governor tripping speed, km/h	
	Governor tested on date	
	Functioning of brake valves, quick release coupling	
	Oil leakages if any	
	Condition of bogie pivot and lubrication	
	Clearance between brake pad and track, mm	
	Testing of brakes manually by operating levers in the cars	
	Function of pantographs on the-both ends of the cars	
	Functioning of Alternator and lighting	
15.	**Electrical Protections On Hauler**	
	Functioning of E/L protection	
	Functioning of O/L protection	
	Functioning of motor bearing temperature protection	
	Functioning of motor winding temperature protection	
	Maintaining of pantograph signal line	
	Functioning of blinkers in the haulage roadway	
	Condition of general lighting in the haulage Roadway	

	Functioning of pre-start alarm and caution message in haulage room and at all stations (Mention the delay time)	
	Separate signal line in the haulage Road apart from pantograph signal line	
	Functioning of loud hailing system in haulage Road.	
GENERAL CONDITIONS		
Condition of Floor along the travel		
Condition of Roof and Sides along the travel		
Red retro reflector at the front and rear sides of the Cars		
Separate SOPs circulated		
Provision of Maintenance shed for checking condition of bogies, etc		
NDT (Test report no. and Date) Attach the copy of test report		
No. of Authorized Fitters		
Name of the Authorized Engineer		
History of Accidents if any		
Overall Performance		
Any other information:		

Name, Date and Signature of Service Engineer

Name, Date and Signature of Safety officer

Name, Date and Signature of Mine Engineer

Name, Date and Signature of Mine Manager

Name, Date and Signature of Agent

Therefore, all are requested to give comments/observation if any through email mentioned below on or before 17.03.2018.

Email Id: dg@dgms.gov.in

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